Analysis of Paynesville-Roscoe Tap-Munson Tap-Farm Tap 69 kV Post-Contingent Line Loadings

Background

The existing Paynesville-Roscoe Tap-Munson Tap-Farm Tap 69 kV line is equipped with 4/0 ACSR conductor, with a nominal Summer rating of 47 MVA. Based upon the results of the Southwest Minnesota/Southeast South Dakota Electric Transmission Study (November, 2001), the resultant "825 MW" Buffalo Ridge series of projects originally included the rebuild of this line to higher capacity.

At a later date, it was determined that this particular rebuild did not appear to be necessary for achieving the 825 MW target outlet capability, but would likely be needed at a somewhat higher outlet level. Consequently, it was removed from the list of "825 MW projects".

During the time between the initial identification of this project and its later de-listing, it was reported during the normal powerflow model building process, as among the "planned facilities". Consequently, in recent years some powerflow models have been issued which represent the Paynesville-Roscoe Tp-Munson Tp-Farm Tp 69 kV as having been rebuilt to higher capacity.

The powerflow analyses undertaken for the Buffalo Ridge Incremental Generation Outlet Study were performed using MISO 2001 Series powerflow models which represented the Paynesville-Roscoe Tp-Munson Tp-Farm Tp 69 kV as rebuilt to high capacity (795 kcm ACSR; 117 MVA). It was recently realized that this likely has resulted in "masking" of an overload which should be appearing in the powerflow analysis outputs. This memorandum summarizes the results of a sensitivity analysis performed for the purpose of evaluating the effect of this modeling discrepancy.

Analysis

The "Option 31A6", "Option 9", and "Option 5" powerflow base case models used in the Buffalo Ridge Incremental Generation Outlet Study analysis were revised to reflect the existing impedance characteristics and rating associated with the Paynesville-Roscoe Tap-Munson Tap-Farm Tap 69 kV line's existing 4/0 conductor. These three Options were chosen as representative of the spectrum of Options studied in the "Incremental" study effort.

As expected, the existing 4/0 conductor does become overloaded within the range of Buffalo Ridge outlet of interest. The following table shows the Buffalo Ridge total

generation outlet levels (rounded to the nearest 10 MW) at which these line sections' post-contingent loadings limit achievable Buffalo Ridge generation outlet.

Option	Buffalo Ridge Area Total Generation Outlet, MW	Limiting Facility (outage = Paynesville-Wakefield 115 kV)
31A	1120	Paynesville-Roscoe Tp 69 @ 110% of 48 MVA
(2nd Nobles Co-Fenton 115 kV)	1210	Roscoe Tp-Munson Tp @ 110% of 48
	1310	Munson Tp-Farm Tp @ 110% of 48
9	1120	Paynesville-Roscoe Tp 69 @ 110% of 48 MVA
(Reconductors)	1210	Roscoe Tp-Munson Tp @ 110% of 48
	1310	Munson Tp-Farm Tp @ 110% of 48
5	1200	Paynesville-Roscoe Tp 69 @ 110% of 48 MVA
(Chanarambie-Watonwan Jct 115)	1300	Roscoe Tp-Munson Tp @ 110% of 48
	1400	Munson Tp-Farm Tp @ 110% of 48

From this table is observed that the first section of this 69 kV line (Paynesville-Roscoe Tp) becomes subject to overload at approximately 1120 - 1200 MW SW MN Buffalo Ridge generation, regardless of transmission Option implemented. Similarly, the next two sections (Roscoe Tp-Muson Tp and Munson Tp-Farm Tp) become subject to overload at 1210 - 1300 MW, and 1310 - 1400 MW, respectively.

The similarity in results observed for the three transmission options is explained by observing that none of the "incremental" Options creates significant network impedance changes in the Paynesville/Wakefield vicinity, nor is there major transmission added which might divert power flows away from the Paynesville 230/115/69 kV transformation. This was confirmed by noting that on the TLTG simulation outputs the "outage transfer distribution factor" ("OTDF") on the Paynesville-Farm Tp 69 kV line, for Buffalo Ridge-->Twin Cities power deliveries, is between 2.3 % and 2.4% regardless of which option is studied. Due to the similar pre-contingent loadings and this small variation in distribution factor, the post-contingent loadings experienced for the Paynesville-Wakefield 115 kV outage are similar, regardless of which "incremental" transmission option is implemented.

After rebuild with heavier conductor--which increases the OTDF slightly, to 2.6%--the post-contingent loadings would be approximately 66 MVA at the 1400 MW Buffalo Ridge generation level. Consequently, the new Paynesville-Roscoe Tp-Munson Tp-Farm Tp 69 kV conductor needs to be at least 477 kcm ACSR or equivalent.

Conclusions

Achieving any target total Southwest Minnesota Buffalo Ridge Area generation outlet capability in excess of approximately 1200 MW will require increased capacity on the Paynesville-Roscoe Tp-Munson Tp-Farm Tp 69 kV line. This finding holds regardless of the particular Buffalo Ridge "Incremental" transmission Option chosen for implementation. The new line conductor should be at least 477 kcm ACSR or equivalent.

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4-11-2005
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